Amendments to the Claims

Please cancel claims 1697, 1717, and 1735 without prejudice.

The following listing of claims will replace all prior versions and/or listings of claims in the application:

Listing of Claims:

1-1690. (cancelled)

1691. (previously presented): A system configured to heat a hydrocarbon containing formation, comprising:

a heater well extending from a surface of the earth through an overburden of the formation and into a hydrocarbon containing layer in the formation;

an AC supply configured to provide AC at a voltage above about 200 volts; and

one or more electrical conductors located in the heater well and extending from the surface into the hydrocarbon containing layer, the electrical conductors being electrically coupled to the AC supply;

at least one electrical conductor comprising one or more ferromagnetic sections, and being configured to provide an electrically resistive heat output during application of AC to the electrical conductor such that heat transfers from the electrical conductor to hydrocarbons in the hydrocarbon containing layer to at least mobilize some hydrocarbons in the layer;

wherein one or more of the ferromagnetic sections provides a reduced amount of heat above or near a selected temperature during use, wherein the selected temperature is at or about the Curie temperature of the ferromagnetic section.

1692. (previously presented): The system of claim 1691, further comprising at least one production well extending into the hydrocarbon containing layer and configured to produce at least some of the mobilized hydrocarbons from the hydrocarbon containing layer.

1693. (previously presented): The system of claim 1691, wherein at least one electrical conductor transfers heat during use to hydrocarbons in the hydrocarbon containing layer to at least mobilize some hydrocarbons in the layer.

1694. (previously presented): The system of claim 1691, wherein at least one electrical conductor transfers heat during use to hydrocarbons in the hydrocarbon containing layer to pyrolyze at least some hydrocarbons in the layer.

1695. (previously presented): The system of claim 1691, wherein at least one of the ferromagnetic sections heats during use to a temperature of at least about 650 °C.

1696. (previously presented): The system of claim 1691, wherein the AC supply is configured to provide AC at a voltage below about 2500 volts.

1697. (cancelled).

1698. (previously presented): The system of claim 1691, wherein the system comprises three or more electrical conductors, and wherein at least three of the electrical conductors are coupled in a three-phase electrical configuration.

1699. (previously presented): The system of claim 1691, wherein at least one of the ferromagnetic sections comprises iron, nickel, chromium, cobalt, tungsten, or a mixture thereof.

1700. (previously presented): The system of claim 1691, wherein at least one of the ferromagnetic sections has a thickness of at least about ¾ of a skin depth of the AC at the Curie temperature of such ferromagnetic sections.

1701. (previously presented): The system of claim 1691, wherein the heat output below the selected temperature is greater than about 400 watts per meter of electrical conductor.

1702. (previously presented): The system of claim 1691, wherein at least a portion of the electrical conductor is longer than about 10 m.

1703. (previously presented): The system of claim 1691, wherein one or more of the ferromagnetic sections are configured to sharply reduce the heat output at or near the selected temperature.

1704. (previously presented): The system of claim 1691, wherein the heat output from at least a portion of the ferromagnetic sections decreases at or near the selected temperature due to the Curie effect.

1705. (previously presented): The system of claim 1691, wherein the AC resistance of the electrical conductor increases with an increase in temperature up to the selected temperature, and wherein the AC resistance of the electrical conductor decreases with an increase in temperature above the selected temperature.

1706. (previously presented): The system of claim 1691, wherein the AC supply provides an electrical current of at least about 70 amps to the electrical conductor.

1707. (previously presented): The system of claim 1691, wherein at least one of the electrical conductors comprises a turndown ratio of at least about 2 to 1.

1708. (previously presented): The system of claim 1691, wherein the AC supply applies AC at about 180 Hz.

1709. (previously presented): The system of claim 1691, wherein the system withstands operating temperatures of about 250 °C or above.

1710. (previously presented): The system of claim 1691, wherein the electrical conductor automatically provides the reduced amount of heat above or near the selected temperature.

1711. (currently amended): A system configured to heat a hydrocarbon containing formation, comprising:

a heater well extending from a surface of the earth through an overburden of the formation and into a hydrocarbon containing layer in the formation;

an AC supply configured to provide AC at a voltage above about 200 volts; and

one or more electrical conductors located in the heater well and extending from the surface into the hydrocarbon containing layer, the electrical conductors being electrically coupled to the AC supply;

at least one electrical conductor comprising one or more ferromagnetic sections, and being configured to provide an electrically resistive heat output during application of AC to the electrical conductor such that heat transfers from the electrical conductor to hydrocarbons in the hydrocarbon containing layer to at least mobilize some hydrocarbons in the layer;

wherein one or more of the ferromagnetic sections provides a reduced amount of heat above or near a selected temperature that is about 20% or less of the heat output at about 50 °C below the selected temperature during use, wherein the selected temperature is at or about the Curie temperature of the ferromagnetic section.

1712. (previously presented): The system of claim 1711, further comprising at least one production well extending into the hydrocarbon containing layer and configured to produce at least some of the mobilized hydrocarbons from the hydrocarbon containing layer.

1713. (previously presented): The system of claim 1711, wherein at least one electrical conductor transfers heat during use to hydrocarbons in the hydrocarbon containing layer to at least mobilize some hydrocarbons in the layer.

1714. (previously presented): The system of claim 1711, wherein at least one electrical conductor transfers heat during use to hydrocarbons in the hydrocarbon containing layer to pyrolyze at least some hydrocarbons in the layer.

1715. (previously presented): The system of claim 1711, wherein at least one of the ferromagnetic sections heats during use to a temperature of at least about 650 °C.

1716. (previously presented): The system of claim 1711, wherein the AC supply is configured to provide AC at a voltage below about 2500 volts.

1717. (cancelled).

1718. (previously presented): The system of claim 1711, wherein the system comprises three or more electrical conductors, and wherein at least three of the electrical conductors are coupled in a three-phase electrical configuration.

1719. (previously presented): The system of claim 1711, wherein at least one of the ferromagnetic sections comprises iron, nickel, chromium, cobalt, tungsten, or a mixture thereof.

1720. (previously presented): The system of claim 1711, wherein at least one of the ferromagnetic sections has a thickness of at least about ¾ of a skin depth of the AC at the Curie temperature of such ferromagnetic sections.

1721. (previously presented): The system of claim 1711, wherein the heat output below the selected temperature is greater than about 400 watts per meter of electrical conductor.

1722. (previously presented): The system of claim 1711, wherein at least a portion of the electrical conductor is longer than about 10 m.

1723. (previously presented): The system of claim 1711, wherein one or more of the ferromagnetic sections are configured to sharply reduce the heat output at or near the selected temperature.

1724. (previously presented): The system of claim 1711, wherein the heat output from at least a portion of the ferromagnetic sections decreases at or near the selected temperature due to the Curie effect.

1725. (previously presented): The system of claim 1711, wherein the AC resistance of the electrical conductor increases with an increase in temperature up to the selected temperature, and wherein the AC resistance of the electrical conductor decreases with an increase in temperature above the selected temperature.

1726. (previously presented): The system of claim 1711, wherein the AC supply provides an electrical current of at least about 70 amps to the electrical conductor.

1727. (previously presented): The system of claim 1711, wherein at least one of the electrical conductors comprises a turndown ratio of at least about 2 to 1.

1728. (previously presented): The system of claim 1711, wherein the AC supply applies AC at about 180 Hz.

1729. (previously presented): The system of claim 1711, wherein the system withstands operating temperatures of about 250 °C or above.

1730. (previously presented): The system of claim 1711, wherein the electrical conductor automatically provides the reduced amount of heat above or near the selected temperature.

1731. (previously presented): A method of heating a hydrocarbon containing formation, comprising:

providing AC at a voltage above about 200 volts to one or more electrical conductors located in a heater well extending from a surface of the earth through an overburden of the formation and into a hydrocarbon containing layer in the formation, wherein providing the AC produces an electrically resistive heat output from the electrical conductors, at least one of the electrical conductors comprising one or more ferromagnetic sections; and

wherein one or more of the ferromagnetic sections are configured to provide a reduced amount of heat above or near a selected temperature during use, wherein the selected temperature is at or about the Curie temperature of the ferromagnetic section; and

allowing heat to transfer from the electrical conductors to hydrocarbons in the hydrocarbon containing layer to at least mobilize some hydrocarbons in the layer.

1732. (previously presented): The method of claim 1731, further comprising producing at least some of the mobilized hydrocarbons from the layer through a production well extending into the hydrocarbon containing layer.

1733. (previously presented): The method of claim 1731, wherein the transferred heat pyrolyzes at least some hydrocarbons in the hydrocarbon containing layer.

1734. (previously presented): The method of claim 1733, further comprising producing at least some of the pyrolyzed hydrocarbons from the layer through a production well extending into the hydrocarbon containing layer.

1735. (cancelled).

1736. (previously presented): The method of claim 1731, wherein at least one of the ferromagnetic sections heats to a temperature of at least about 650 °C.

1737. (previously presented): The method of claim 1731, further comprising providing the AC at a voltage below about 2500 volts.

1738. (previously presented): The method of claim 1731, further comprising providing the AC to at least one of the electrical conductors at or above the selected temperature.

1739. (previously presented): The method of claim 1731, further comprising providing the AC at a frequency of about 180 Hz.

1740. (previously presented): The method of claim 1731, further comprising providing an initial electrically resistive heat output when the electrical conductor providing the heat output is at least about 50 °C below the selected temperature, and automatically providing the reduced amount of heat above or near the selected temperature.

1741. (previously presented): The method of claim 1731, wherein an AC resistance of at least one of the ferromagnetic sections decreases above the selected temperature to provide the reduced amount of heat.

1742. (previously presented): The method of claim 1731, wherein at least one of the ferromagnetic sections has a thickness of at least about ¾ of a skin depth of AC at the Curie temperature of the ferromagnetic material.

1743. (previously presented): The method of claim 1731, wherein the reduced amount of heat is less than about 400 watts per meter of length of electrical conductor.

1744. (previously presented): The method of claim 1731, further comprising controlling a skin depth in at least one of the ferromagnetic sections by controlling a frequency of the applied AC.

1745. (previously presented): The method of claim 1731, further comprising applying additional current to at least one of the ferromagnetic sections as the temperature of such ferromagnetic sections increases until the temperature is at or near the selected temperature.

1746. (previously presented): The method of claim 1731, further comprising controlling an amount of heat provided by at least one of the ferromagnetic sections by controlling an amount of current applied to at least one of the electrical conductors.

1747. (previously presented): The method of claim 1731, further comprising applying current of at least about 70 amps to at least one of the electrical conductors.

1748. (previously presented): The system of claim 1691, wherein the heater well extends at least about 10 m into the hydrocarbon containing layer.

1749. (previously presented): The system of claim 1691, wherein the hydrocarbon containing layer comprises hydrocarbons configured to be treated and produced from the formation using an in situ conversion process.

1750. (previously presented): The system of claim 1711, wherein the heater well extends at least about 10 m into the hydrocarbon containing layer.

1751. (previously presented): The system of claim 1711, wherein the hydrocarbon containing layer comprises hydrocarbons configured to be treated and produced from the formation using an in situ conversion process.

1752. (previously presented): The method of claim 1731, wherein the heater well extends at least about 10 m into the hydrocarbon containing layer.

1753. (previously presented): The method of claim 1731, wherein the hydrocarbon containing layer comprises hydrocarbons configured to be treated and produced from the formation using an in situ conversion process.